

Catalog of the Fossil Isoptera of the New World

by

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ABSTRACT

A Catalog on the New World fossil termites, termite ichnofossils and related subjects is presented. The number of taxa registered are: 22 genera (of which 10 are exclusively fossil) and 34 species, 4 ichnogenera and 4 ichnospecies.

INTRODUCTION

The interest on fossil termites and termite traces enlarged considerably in the last decade. A series of new scientific acquisitions and concepts has contributed to this. As examples, we mention the exploration of new deposits of the Cretaceous age (mainly the Santana Formation in the northeast region of Brazil), descriptions of many ichnofossils (including nests and tunnels), studies on the essential role of termites in the metamorphosis of tropical soils and rocks (including soil formation and regeneration, and the major contribution of the insect to laterite formation), and new technology on molecular biology that has put termites in evidence through studies of DNA of fossil specimens.

Recent accounts, with discussion and a comprehensive bibliography, are available on the fossil history of termites (Thorne *et al.* 2000), insect trace fossils (Genise *et al.* 2000), ancient patterns of termite nest construction (Genise & Bown 1994), and termites of the Santana Formation and the contribution of termites to the genesis of laterites (Fontes & Vulcano 1998).

The New World has now 22 genera, of which 10 are exclusively fossil, and 34 species of fossil termites. There is also a considerable collection of information on termite traces (including the description of 4 ichnogenera and 4 ichnospecies) and other related subjects, as symbiotic and parasitic organisms, and data on molecular biology of fossil species.

LIST OF ABBREVIATIONS FOR TYPE DEPOSITORIES

AMNH — American Museum of Natural History, New York, USA.

DNPM — Divisão de Paleontologia, Departamento Nacional da Produção Mineral, Rio de Janeiro, Brazil.

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LACM — Los Angeles County Museum, Los Angeles, USA.

MACN — Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina.

MAVC — M. A. Vulcano, São Paulo, Brazil (private collection).

MCFLC — Museo de la Ciencia de la Fundación La Caixa, Barcelona, Spain.

MCZC — Museum of Comparative Zoology, Cambridge, USA.

MLPC — Museo de La Plata, Buenos Aires, Argentina.

MPUC — Museum of Paleontology, University of California, Berkeley, USA.

PEFO — Petrified Forest National Park Museum, Arizona, USA.

PUIC — Princeton University Collection of Paleontological Invertebrates, Princeton, USA.

USNM — National Museum of Natural History (previously United States National Museum), Washington, USA.

FOSSIL ISOPTERA

Bibliography: Burnham 1978: 85-93; Carpenter 1992; Fontes & Vulcano 1998; Thorne *et al.* 2000.

HODOTERMITIDAE

CARINATERMITINAE

CARINATERMITINAE Krishna & Grimaldi, 2000: 134-136.

Carinatermes Krishna & Grimaldi, 2000: 134.

Type species: *C. nascimbeni* Krishna & Grimaldi 2000.

C. nascimbeni Krishna & Grimaldi, 2000: 136-137, Figs. 1-2 (alate: head, pronotum, fore wing, fore coxae, posterior tip of abdomen, cercus, tibia and tarsus).

Type locality: USA, New Jersey, White Oaks (Crossman's) Pits, Sayreville. Turonian, Upper Cretaceous. Type: AMNH (nr. NJ-124).

Bibliography: Thorne *et al.* 2000, fig. 5b (alate).

CRETATERMITINAE

CRETATERMITINAE Emerson 1967: 278-281.

Cretatermes Emerson, 1967: 284-285.

Type species: *C. carpenteri* Emerson, 1967.

C. araripena (Krishna), 1990: 76-77, Figs. 1-3 (alate: head, pronotum, fore leg, cercus, fore and hind wings) [*Meiatermes*].

Type locality: Brazil, Chapada do Araripe. Santana Formation, Lower Cretaceous. Type: AMNH (nr. 43902).

Bibliography: Fontes & Vulcano 1998: 246-265, Figs. 1-28 (alates). see Fig. 1 (below) and Fig. 2 (overleaf).



Fig. 1. *Cretatermes araripena*, alate in dorsal view. Body and wings reasonably preserved. Pronotum and part of head (with left eye) well preserved. Collection of MAVC (nr. 5002)

C. carpenteri

Emerson, 1967: 285-288, Figs. 1-3 (fore wing).

Type locality: Canada, Labrador: near Schefferville (54°50'N, 67°00'W).

Type: PUIC (nr. 87270).

Bibliography: Grassé 1986, Fig. 274 (fore wing); Thorne *et al.*, 2000, Fig. 5a (fore wing).

C. pereirai

Fontes & Vulcano, 1998: 265-269, figs. 29-30, 35-38 (alate).

Type locality: Brazil, Chapada do Araripe. Santana Formation, Lower Cretaceous. Type: MAVC (nr. 2452).



Fig.2. *Cretatermes araripena*, alate in dorsal view, Body reasonably preserved, with wings contour. Some appendices of the head and parts of the pronotum preserved. Collection of MAVC (nr. 1718)

HODOTERMITINAE

Mariconitermes Fontes & Vulcano, 1998: 269-270.

Type species: *M. talicei* Fontes & Vulcano, 1998.

M. talicei Fontes & Vulcano, 1998: 270-276, Figs. 31-34, 39-42 (alate: head, pronotum, mesonotum, metanotum, cerci).

Type locality: Brazil, Chapada do Araripe. Santana Formation, Lower Cretaceous. Type: MAVC (nr. 5006). Fig. 3 (at right)



Fig. 3. *Mariconitermes talicej*, dealate in dorsal view. Well preserved specimen. Holotype, collection of MAVC (nr. 5006)

region). Amber, Oligocene-Miocene. Type: MPUC.

Distribution: Mexico, Ixhuatan (Tapilula River = Teapa River).

Cryptotermes

Type species: *C. cavifrons* Banks, 1906 (extant).

Ulmeriella Meunier, 1920: 728.

Type species: *U. bauckhorni* Meunier 1920.

Bibliography: Emerson, 1968: 6-10 (revision).

U. latahensis

Snyder, 1949b: 164, Fig. 1 (hind wing).

Type locality: USA, Washington: Cut nr. 1, Portland Seattle Railroad (47°40'N, 117°25'W). Latah Formation, Upper Miocene. Type: USNM.

Bibliography: Emerson 1968: 18-19.

U. rubiensis

Lewis, 1973: 1359-1360, Fig. 1 (wing).

Type locality: USA, Montana, Alder. Oligocene. Type: AMNH.

KALOTERMITIDAE

Bibliography: Krishna 1961; Emerson 1969.

Calcaritermes

Type species: *C. imminens*, (Snyder 1925) [*Kalotermes*] (extant).

C. vetus

Emerson, 1969: 39-43, Fig. 10 (alate).

Type locality: Mexico, Chiapas, Vega de la Campam (São Pedro River, Simojovel

C. ryshkoffi Pierce, 1958: 19, pl. 5, Fig. 1 (wings), pl. 6, Fig. 6 (rock nodule).

Type locality: USA, California, Calico Mts. Type: LACM.

Bibliography: Emerson, 1969: 52-53.

C. yamini Krishna & Bacchus, 1987: 2-3, Figs. 1-2 (alate).

Type locality: Dominican Republic. Amber, Upper Oligocene or Lower Miocene. Type: AMNH.

Incisitermes

Type species: *I. schwarzi* (Banks, 1920) [*Kaloterme*s] (extant).

I. krishnai Emerson, 1969: 46-52, Fig. 12 (alate).

Type locality: México, Chiapas, Simojovel region. Amber, Miocene-Oligocene. Type: MPUC.

Synonym: *Kaloterme*s *nigritus* Snyder, 1960: 493 (not Snyder, 1946; wrong identification), México.

Proelectrotermes von Rosen, 1913: 331 [*Caloterme*s subg. *Proelectrotermes*].

Type species: *P. berendtii* Pictet, 1854 [*Termes*].

Bibliography: Emerson, 1942: 9, 10; Krishna, 1961: 317-318; Emerson, 1969: 14-15; Engel & Krishna, 2001.

P. fodinae (Scudder) 1883: 141 (alate) [*Paroterme*s].

Type locality: USA, Colorado, Florissant. Lower Oligocene (cf. Emerson, 1971: 282). Type: MCZC.

Bibliography: Emerson 1969: 19-22, Fig. 5 (A: mandibles, B: pronotum, C: wing).

Prokalotermes Emerson 1933: 189.

Type species: *Prokaloterme*s *hageni* Scudder, 1890.

Bibliography: Krishna 1961: 331; Emerson, 1969: 11-12.

P. (?) alderensis Lewis 1976: 313-315, Fig. 1 (alate).

Type locality: USA, Montana, Alder. Upper Oligocene. Type: AMNH.

P. hageni (Scudder) 1890: 110, 112, pl. 12, Fig. 2 (alate) [*Paroterme*s].

Type locality: USA, Colorado, Florissant. Lower Oligocene (cf. Emerson, 1971: 282). Type: MCZC.

Bibliography: Emerson 1969: 12-14, fig. 3 (A: mandible; E: wing).

MASTOTERMITIDAE

Bibliography: Emerson 1965.

Blattotermes Riek, 1952: 17-20.

Type species: *B. neoxenus* Riek, 1952.

Bibliography: Emerson 1965: 24, Fig. 1 (distribution of species).

B. wheeleri (Collins), 1925: 406, Fig. 2 (fore wing) [*Mastotermes*].

Type locality: USA, Tennessee, Grand Junction (35°03'N, 89°10'W).

Lower Eocene. Type: USNM.

Bibliography: Emerson 1965: 25.

Mastotermes Froggatt, 1896: 517, 519.

Type species: *M. darwiniensis* Froggatt 1896 (extant).

Bibliography: Emerson 1965: 25-28, Figs. 2-3 (distribution of species).

Synonym: *Pliotermes* S. Pongrácz 1917: 28. Type species: *P. hungaricus* S. Pongrácz, 1917.

M. electrodominicus Krishna & Grimaldi, 1991: 3-6, Figs. 1-3 (nymph), 4-15 (alate).

Type locality: Dominican Republic. Amber, Upper Oligocene or Lower Miocene. Type: AMNH.

Bibliography: Thorne *et al.* 2000, fig. 6 (A: alate; B: worker; C: soldier).

M. electromexicus Krishna & Emerson, 1983: 2-7, Figs. 1-2 (alate), 3 (soldier), 4 (nymph).

Type locality: Mexico, Chiapas, Simojovel Region (18°19'N, 92°40'S). Amber, Upper Oligocene or Lower Miocene. Type: MPUC.

Spargotermes Emerson, 1965: 19-21.

Type species: *S. costalimai* Emerson, 1965.

S. costalimai Emerson, 1965: 21-24, Figs. 1 (distribution), 4a-c (wing).

Type locality: Brazil, Minas Gerais, Distrito de Alvinópolis, Fonseca (20°10'S, 43°18'W). Type: DNPM.

Bibliography: Grassé 1986, Fig. 247 (hind wing).

Synonym: *Mastotermes*? sp. Lima 1944: 291-292, plate (wing).

TERMOPSIDAE

Bibliography: Engel *et al.* 2003.

TERMOPSINAE

Bibliography: Emerson 1933.

Parotermes Scudder, 1883: 135-137.

Type species: *P. insignis* Scudder 1883.

Bibliography: Emerson 1933: 171-172.

P. insignis Scudder, 1883: 137-139 (alate).

Type locality: USA, Colorado, Florissant. Lower Oligocene (cf. Emerson, 1971: 282). Type: MCZC.

Bibliography: Zittel 1885: 773, Fig. 974 (wing); Scudder, 1890: 108, pl. 12, Figs. 13-14; Emerson, 1933: 168 (key), 172, Figs. 5-7 (left mandible, pronotum, tarsum).

Zootermopsis

Type species: *Z. angusticollis* (Hagen 1858) [*Termopsis*] (extant).

Z. (?) coloradensis (Scudder), 1883: 142-143 (alate) [*Hodotermes*].

Type locality: USA, Colorado, Florissant. Lower Oligocene (cf. Emerson, 1971: 282). Type: MCZC.

Bibliography: Scudder 1890: 113, pl. 12, Fig. 6; Cockerell 1908, Fig. without number (p. 118; alate) [*Hodotermes*]; Emerson 1933: 187-188, Fig. 40 (fore wing).

Synonym: *Parotermes scudderi* Cockerell, 1913: 8. Type locality: USA, Colorado, Florissant. Lower Oligocene. Bibliography: Snyder, 1925: 154, 159 (notes).

RHINOTERMITIDAE

Bibliography: Emerson 1971; Krishna & Grimaldi, 2003.

COPTOTERMITINAE**Coptotermes**

Type species: *C. gestroi* (Wasmann, 1896) [*Termes*] (extant).

C. priscus Emerson, 1971: 268-270, Fig. 3a,d (alate: pronotum, wing).

Type locality: Dominican Republic. Amber, Oligocene-Miocene. Type: AMNH.

C. sucineus Emerson, 1971: 270-272, Fig. 3b-c,e (alate: pronotum, wing).

Type locality: Mexico, Chiapas, B-5103 (ca. 23 km SE Simojovel). Amber, Upper Oligocene or Middle Miocene. Type: MPUC (nr. 12679B).

Bibliography: Snyder 1960, plate 70, Fig. 1 (alate on left side).

HETEROTERMITINAE

Heterotermes

Type species: *H. platycephalus*, Froggatt 1925 (extant).

H. primaevus Snyder, 1960: 493-494, pl. 70, Figs. 1 (alate on right side)-2 (alate).

Type locality: Mexico, Chiapas, B-5103 (ca. 23 km SE Simojovel). Amber, Upper Oligocene or Middle Miocene. Type: MPUC (nr. 12679A).

Bibliography: Emerson 1971: 274-276, Fig. 5a-d (alate).

Reticulitermes

Type species: *R. flavipes* (Kollar 1837) [*Termes*] (extant).

R. creedei Snyder, 1938: 109, pl. 13, Fig. 3 (wing).

Type locality: USA, Colorado, near Creede. Type: MCZC.

Bibliography: Emerson, 1971: 284-285.

R. fossarum (Scudder), 1883: 143 (alate) [*Eutermes*]

Type locality: USA, Colorado, Florissant. Lower Oligocene. Type: MCZC (Lectotype nr. 271).

Bibliography: Emerson 1971: 281-282. Scudder 1890: 115, pl. 12, Fig. 20 (alate)

Synonym: *Eutermes meadit* Scudder, 1883: 144-145. Type locality: USA, Colorado, Florissant. Lower Oligocene. Type: MCZC (Lectotype nr. 272). Bibliography: Scudder, 1890: 115, pl. 12, Figs. 12, 17 (alate).

R. laurae Pierce, 1958: 20-21, pl. 5, Fig. 3 (wing), pl. 6, Fig. 8 (rock nodule), pl. 7, Fig. 10 (wing).

Type locality: USA, California, Calico Mountains. Lower Miocene. Type: LACM.

Bibliography: Emerson 1971: 285-286, Figs. 8-9 (wings).

RHINOTERMITINAE

Dolichorhinotermes

Type species: *D. longilabius* (Emerson, 1925) [*Rhinotermes*] (extant).

D. dominicanus Schlemmermeyer & Canello, 2000: 305, Figs. 1-3 (alate).

Type locality: Dominican Republic. Amber, Miocene. Type: MCFLC (nr. MCFLC/MCAM-0248).

STYLOTERMITINAE

Bibliography: Emerson 1971: 287.

Parastylotermes Snyder & Emerson (*in* Snyder), 1949: 366, 378.

Type species: *Stylotermes washingtonensis* Snyder 1931.

Bibliography: Emerson 1971: 290-292.

P. calico Pierce, 1958: 20-21, pl. 5, Fig. 2 (wing), pl. 6, Fig 7 (rock nodule).

Type locality: USA, California, Switchback Canyon, Yermo Quadrangle (ca. 35°00'N, 116°51'W), Calico Mountains (San Bernardino County). Middle Miocene. Type: LACM.

Bibliography: Emerson 1971: 295, Fig. 15 (wing).

P. frazieri Snyder, 1955: 80, Fig. 1 (wing).

Type locality: USA, California, Ventura County (Old Frazier Borax Mine), Mt. Pinos Quadrangle. Middle Miocene. Type: USNM.

Bibliography: Emerson, 1971: 294-295.

P. washingtonensis (Snyder), 1931: 317, pl. 1, Fig. 5 (wing) [*Stylotermes*].

Type locality: USA, Washington, near Spokane. Upper Miocene. Type: MCZC.

Bibliography: Snyder, 1948: 16, Fig. 4 (wing); Emerson, 1971: 295-296 (wing).

TERMITIDAE

TERMITINAE

Gnathamitermes

Type species: *G. perplexus* (Banks, 1920) [*Amitermes*] (extant).

G. rousei Pierce, 1958: 21-22, pl. 5, Fig. 5 (wing), pl. 6, Fig. 9 (rock nodule) [*Gnathamitermes magnoculus rousei*].

Type locality: USA, California, Calico Mountains. Miocene. Type: LACM.

Bibliography: Krishna, 1996: 2, taxonomy (*G. magnoculus rousi* and *G. rousi*, wrong spelling).

NASUTITERMITINAE

Bibliography: Fontes 1998 (worker digestive tube; phylogeny of Neotropical genera).

Constrictotermes

Type species: *C. cyphergaster* (Silvestri, 1901) [*Eutermes*] (extant).

Bibliography: Krishna, 1996: 3-7.

C. electroconstrictus Krishna, 1996: 3-4, Figs. 1-2 (head of soldier), Fig 3 (soldier).

Type locality: Dominican Republic. Amber, Upper Oligocene or Lower Miocene. Type: AMNH.

Nasutitermes

Type species: *N. sanchezi* (Holmgren, 1910) [*Eutermes*] (extant). This name is a junior synonym of *N. costalis* (Holmgren, 1910), as designated by Emerson (1925: 379), but valid as type species according to the International Code of Zoological Nomenclature (Sands 1965: 15-17).

Bibliography: Krishna 1996: 4-8.

N. electrinus Krishna, 1996: 10-11 (alado).

Type locality: Mexico, Chiapas, Simojovel region (18°19'N, 92°40'W). Amber, Upper Oligocene or Lower Miocene. Type: MPUC.

N. electronasutus Krishna, 1996: 8-10, Figs. 7-8 (head of soldier).

Type locality: Dominican Republic. Amber, Upper Oligocene or Lower Miocene. Type: AMNH.

Unidentified

Schlee & Gloeckner 1978, coverpicture.

Locality: Dominican Republic. Amber, Upper Oligocene or Lower Miocene.

Bibliography: Schlee 1980, pl. 35 (head of soldier); Boucot 1990: 479, Figs. 389 (entire soldier), 390 (head of soldier).

Unidentified

Muellenmeister 2001: 15 (Fig.. of worker), 21 (Fig.. of three soldiers).

Locality: Dominican Republic. Amber, Upper Oligocene or Lower Miocene.

TERMITE ICHNOFOSSILS

Nest and fecal pellets within wood

Bibliography: Boucot, 1990: 376-378, 482; Genise, 1993a.

KALOTERMITIDAE***Incisitermes******I. cf. minor***

Lance, 1946: 21-27, Fig. 1 (tar-impregnated root of *Pinus* with fecal pellets), 2 (fecal pellets) [*Kaloterмес*].

Locality: USA, California, Santa Barbara County, Carpinteria. Pleistocene.

Bibliography: Boucot, 1990: 376.

Unidentified

Cycalichnus Genise, 1995: 294. Type species: *Cycalichnus garciorum* Genise 1995.

Cycalichnus garciorum Genise, 1995: 294-295, Figs. 1 (map), 2 (D: nest made of galleries with fecal pellets in a permineralized cycad stem; E: mass of fecal pellets), 5 (nest).

Type locality: Argentina, Rio Negro Province, 100 km N Valcheta. Upper Cretaceous. Type: MACN (nr. 53818).

Unidentified

Light 1930: 75-76, pl. 8, Figs. 1-2 (separated fossil fecal pellets and mass of fecal pellets), pl. 9 (magnified mass of fecal pellets, mineralized by calcium carbonate). In size the fossil pellets are similar to those of the extant species *Incisitermes schwarzi* [*Kaloterмес*], also found in the same region (p. 76; pl. 8, Fig. 3, fecal pellets).

Locality: USA, Florida, St. Petersburg. Pleistocene.

Unidentified

Rogers 1938: 389-392, Figs. 1 (chambers and galleries in conifer wood packed with fecal pellets), 2-3 (thin section of opalized fecal pellets). No identification of family or genus originally assigned.

Locality: USA, California, Santa Barbara County, Santa Maria. Pliocene.

Unidentified

Rohr *et al.*, 1986: 87-88, Figs. 2 (galleries and frass), 3 (silicified fecal pellets).

Locality: USA, Texas, Brewster County. Upper Cretaceous. USNM (nr. 349402).

Bibliography: Boucot 1990: 377-378, fig. 310 (fecal pellets).

TERMOPSIDAE

Zootermopsis

Z. cf. nevadensis

Lance 1946: 21-27, Figs. 1 (tar-impregnated root of *Pinus* with fecal pellets), 3 (fecal pellets).

Locality: USA, California, Santa Barbara County, Carpinteria. Pleistocene.

Bibliography: Boucot 1990: 376.

TRACE GALLERIES AND TERMITIC REMAINS IN THE MANTLEROCK

General bibliography: Machado 1983b; Grassé 1986.

Fontes, 1984a-b (lateritic subsoil in the Amazon Region: Tucuruí, Pará State, Brazil).

Fontes & Vulcano 1998: 285-291 (tunnels in lateritic subsoil in the Amazon Region: Tucuruí, Pará State, Brazil; Figs. 43-44: block of subsoil of residual basaltic origin crossed by termitic small and large galleries).

Hasiotis & Dubiel 1995: 121-125 (galleries and chambers of *Archeoentomichnus metapolypholeos*; Fig. 5: subterranean galleries and chambers).

Machado 1983a (termitic remains in bauxite from Guatemala); 1987 (pisolithic ferruginous bauxite from Canada is not of Precambrian age, but Cretaceous or Tertiary; Fig. 1: map; Figs. 2-6: rock and structural details; Figs. 7-23: animal and plant remains; Fig. 24: termite gut protozoan); 1994 (role of termite gut protozoans in the fixation of iron oxides in laterites; universal occurrence of gut microfossils in laterites; gut microfossil composition of silt fraction of soil is similar to those of laterites; Fig. 7: microfossils from silt of soil from Tucuruí, State of Amazonas, Brazil).

Martins & Leonardos 1992 (pelletal structures with sulfides in laterites; Fig. 1: termite bioturbation in the excavation site; Figs. 2-6: pellets).

Taltasse 1957 ("Cabeças de Jacaré" Formation, Floriano, Piauí State, Brazil; Fig. 1: map; Figs. 2-3: tunnels in soil profile; Fig. 2 reproduced in Grassé, 1986: 435, Fig. 244).

SUBTERRANEAN NESTS AND GALLERIES

Bibliography: Boucot 1990: 473- 475, 482; Genise 1993b: 54.

Cornitermes

Tacuruichnus Genise, 1997: 140. Type species: *Tacuruichnus farinai* Genise, 1997.

Tacuruichnus farinai Genise, 1997: 140-142, Figs. 1 (map), 2 (nest).

Type locality: Argentina, Buenos Aires Province, Miramar. Upper Pliocene. Type: phototypes (Fig. 2a of original paper).

Procornitermes

Locality: Argentina, Buenos Aires Province, General Pueyrredón. Upper Pliocene.

Bibliography: Laza 1995: 343-345, Fig. 1 (map).

Syntermes

Syntermesichnus Bown & Laza, 1990: 74. Type species: *Syntermesichnus fontanae* Bown & Laza, 1990.

Syntermesichnus fontanae Bown & Laza, 1990: 74-75, Figs. 1 (map), 2-4 (nest).

Type locality: Argentina, Santa Cruz Province, Arroyo Feo (46°57'01"S, 70°40'17"W). Miocene. Type: MLPC (nr. 24167).

Termes

Locality: Argentina, Buenos Aires Province, Necochea. Upper Pliocene to Lower Pleistocene.

Bibliography: Laza 1995: 345-347, Fig. 2 (map).

Unidentified

Archeoentomichnus Hasiotis & Dubiel, 1995: 121. Type species: *Archeoentomichnus metapolypholeos* Hasiotis & Dubiel, 1995.

Archeoentomichnus metapolypholeos Hasiotis & Dubiel, 1995: 121-125, Figs. 3-4 (nests), 5 (subterranean galleries and chambers).

Type locality: USA, Arizona, Petrified Forest National Park (34°54'45"N, 109°44'40"W). Upper Triassic. Type: PEFO (nr. 10348).

Unidentified

Hasiotis & Demko 1996: 364-365, Fig. 8 (subterranean galleries and nests closely associated to plant root systems or rhizoliths). No identification of family or genus originally assigned.

Locality: USA, Colorado and Utah States. Upper Jurassic.

Unidentified

Genise *et al.* 1998: 12-13 (nest similar to *Krausichnus* of Tertiary from Egypt or extant *Procornitermes* from South America).

Locality: Uruguay, Soriano Province, Pedro Chico (70 km NE Nueva Palmira). Upper Cretaceous to Lower Tertiary.

Unidentified

DeCelles & Horton 2003: 64 (nest similar to *Krausichnus* of Tertiary from Egypt), Figs. 6B-C.

Locality: Bolivia (Eastern Cordillera of southern central Bolivia). Oligocene to Early Miocene.

OTHER DATA RELATED TO FOSSIL TERMITES

Symbiotic microfossils

Machado 1987 (pisolithic ferruginous bauxite from Canada; fig. 24: termite gut protozoan); 1994 (role of termite gut protozoans in the fixation of iron oxides in laterites; universal occurrence of gut microfossils in laterites; gut microfossil composition of silt fraction of soil is similar to those of laterites; Fig. 7: microfossils from silt of soil from Tucuruí, State of Pará, Brazil).

Wier *et al.* 2002 (fossil symbiotic microbes in *Mastotermes electrodominicus*, in amber from Costa Rica; Fig. 1: termite in amber; Figs. 2-4: fossil protists; Fig. 5: fossil plant tissue).

Parasitic fungi

Poinar & Thomas 1982 (mycelial growth of insect-parasitic fungi, probably *Entomophthora*, covering the abdomen and thorax of a termite worker from Dominican amber; Fig. 1: termite in amber with white mycelial growth; Fig. 2: mycelium and conidiophores).

Molecular biology (DNA)

DeSalle *et al.* 1992 (DNA was extracted from *Mastotermes electrodominicus* preserved in Oligo-Miocene amber, and fragments of mitochondrial and nuclear genes were amplified); 1993 (PCR amplification of *M. electrodominicus* DNA resulted in recombinant clones).

DeSalle *et al.*, 1993 (PCR jumping in clones of DNA extracted from *Mastotermes electrodominicus* preserved in Oligo-Miocene amber).

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